

On some Earthworms from Singapore and the Malay Peninsula

By G. E. GATES,

Judson College, Rangoon, Burma

The Director of the Raffles Museum has forwarded a small collection of earthworms most of which were collected by the Curator, Mr. M. W. F. Tweedie on the Island of Singapore and preserved according to the method used in the work on the Burmese fauna. The specimens are in unusually good condition. The writer's thanks are tendered to the Director not only for the opportunity of studying these worms but also for the care with which the material was preserved.

	Page
Genus <i>Pheretima</i> Kinberg .. .	189
<i>Pheretima arcuata</i> sp.n. .. .	189
<i>Pheretima brinchangensis</i> Stephenson 1932 .. .	192
<i>Pheretima houletti</i> (E. Perrier) 1872 .. .	193
<i>Pheretima indica</i> (Horst) 1883 .. .	193
<i>Pheretima peguana</i> (Rosa) 1890 .. .	193
<i>Pheretima procera</i> sp.n. .. .	193
Genus <i>Perionyx</i> E. Perrier .. .	197
<i>Perionyx violaceus</i> Horst 1893 .. .	197
<i>Perionyx</i> species .. .	197
Genus <i>Pontoscolex</i> Schmarda .. .	197
<i>Pontoscolex corethrurus</i> (Fr. Müller) 1857 .. .	197

Genus PHERETIMA Kinberg

Pheretima arcuata sp.n. Fig. 1.

Bukit Timah, Singapore, Feb. 1936, 3 clitellate specimens, one of which is ruptured in the region of segments v-viii.

External characteristics.—Length, 73–92 mm. The longest specimen had probably autotomized a part of the tail region. Diameter, 2½–3½ mm. Pigmentation, slight, red, restricted to the dorsum anterior to the clitellum.



Fig. 1. *Pheretima arcuata* sp.n.
Spermatheca; \times ca. 21.

The setæ begin on ii on which segment there is a complete circle; setæ present ventrally on xvi. Formulae: 26/iii, 38/viii, 40/xii, 1/xvi, 37/xx; 25/iii, 36/viii, 35/xii, 6/xvi, 33/xx (thecal specimen); 25/iii, 35/viii, 35/xii, 4/xvi, 34/xx.

The first dorsal pore is on 11/12 (3).

The clitellum is annular and extends from 13/14 to 16/17; intersegmental furrows and dorsal pores lacking.

Two specimens are athecal. On the thecal specimen a definite spermathecal pore cannot be identified but the site of the pore is indicated by a very minute, greyish spot, on 8/9, at or near the midventral line.

The male pores are minute and invaginate, each pore at the ventral end of a slenderly conical penis on the roof of a longitudinally ovoidal, copulatory chamber the external aperture of which is located in the lateral portion of a transversely oval, median, unpaired depression with a minutely lobulated, slightly protuberant, annular lip. The oval aperture is about three inter-setal intervals wide, and is located on a slight but not definitely demarcated elevation. The roof of the oval depression is lowest in the region of the midventral line, and laterally on each side slopes dorsally. The apertures of the copulatory chambers are longitudinally slit-like and concealed from view by the lateral portions of the annular lip of the oval aperture.

External genital markings are lacking on one specimen and cannot be recognized on a second as a result of a rupture in the region where the markings should be located. On the third specimen there is a pair of presetal markings on vii, separated midventrally by a space about equal to 4 inter-setal intervals. Each marking is about 1 inter-setal interval wide, transversely oval to almost circular.

Internal anatomy.—Septa 5/6-7/8 are strengthened but translucent; 8/9-9/10 lacking; 10/11-12/13 strengthened but also translucent.

The intestine begins in xv (3). There is a low glandular collar on the oesophagus just behind the gizzard (3). The

intestinal cæca are simple but with slight septal constrictions and extend through 3-4 segments.

The single heart of ix is on the left side (2) and in both of these worms the ventral trunk is continued anteriorly. In the other specimen there is a pair of hearts belonging to ix and the ventral blood vessel appears to end with these hearts, at least no anterior continuation of the trunk could be found. The last pair of hearts is in xiii (3). All hearts of ix-xiii pass into the ventral blood vessel.

The testis sacs are unpaired and annular. The seminal vesicles of xi are included within the posterior testis sac, each vesicle imbedded in the testicular coagulum. The hearts of x and xi are adherent to the mesial faces of the testis sacs which are bulged internally by the vessels. The dorsal trunk is within the testis sacs. The median wall of the testis sac is loosely adherent to the gut in the dorsal half of the worm. The prostates extend through xvii-xx or xxi. The prostatic duct is about 4 mm. long, with a whitish sheen, bent into a U-shaped loop, the ectal limb much thicker than the ental limb. The prostatic duct at first appears to be widened ectally but is actually narrowed as it passes into the dorsal face of a copulatory chamber which is slightly protuberant into the cœlomic cavity, the ectalmost portion of the duct and the entrance into the chamber covered over by connective tissue. On the anterior face of the copulatory chamber are several, closely crowded, stalked glands. Within the chamber and on the median wall are small genital markings, four can be definitely identified but there may be others. The ventral or tip portion of the penis is almost filamentous.

The spermathecal ampulla is small, empty, the wall thin and translucent. The duct is shorter than the ampulla and abruptly narrowed within the parietes. The diverticulum is longer than the combined lengths of duct and ampulla, has a slight, whitish sheen and is bent into a crescentic shape, the concave side of the crescent facing the ampulla. Ectally the width of the diverticulum nearly equals the length of the duct, the diverticular-duct junction not clearly indicated, either externally or internally. The lumen in the ectal part of the duct within the parietes is very narrow, straight and with smooth wall. In the ental portion of the duct and in the diverticulum the lumen is wide and the wall ridged, the ridges longitudinal within the diverticulum and within the duct continued up to the base of the ampulla, the ridges more closely crowded in the ental portion of the diverticulum than ectally.

Glands of the preclitellar genital markings were not found.

Remarks.—*P. arcuata* resembles an undescribed species of *Pheretima* from Burma in the location of the secondary male apertures within an unpaired, transversely placed, median depression. It is unfortunate that so few specimens have been available for study. The athenecal condition may be an abnormality possibly brought about as the result of activities of parasites at some earlier stage as in certain Burmese species of *Pheretima*. Similarly the monothechal condition may also be an abnormality but must be assumed to be characteristic of the species in absence of evidence to the contrary. One other species with a single spermathecal pore is known, *P. michaelseni* Ude 1925 and in this form the spermathecal pore is mid-dorsal while there are two diverticula on the spermatheca.

Diagnosis.—Monothechal, spermathecal pore minute and superficial, on 8/9 at or near the midventral line. Male pores minute and invaginate, each pore at the ventral end of a slenderly conical penis on the roof of a copulatory chamber, the longitudinally slit-like apertures of both copulatory chambers within a transversely oval, median depression. Genital markings small; an external pair presetal on vii, four markings at least on the median wall of each copulatory chamber. Setæ present ventrally on xvi: 25–26/iii, 35–38/viii, 35–40/xii, 1–6/xvi, 33–37/xx. First dorsal pore on 11/12. Length, 73–92 mm. Diameter, 3–3½ mm.

Intestinal caeca simple. Testis sacs unpaired and annular. Seminal vesicles of xi included within the posterior testis sac. Spermathecal diverticulum longer than combined lengths of duct and ampulla, muscular, bent into a crescent shape, ectal portion thicker than the duct, no differentiation into stalk and seminal chamber. Stalked and coelomic glands on the anterior face of each copulatory chamber.

Pheretima brinchangensis Stephenson.

Pheretima brinchangensis Stephenson 1932, Bull. Raffles Mus. no. 7, p. 42. (Type locality, Brinchang Road, Cameron Highlands, Pahang. Types in the British Museum.)

Bukit Chintamani, near Bentong, Pahang, 1 clitellate specimen.

Setal formula: viii/7+41, xvii/20, xviii/12, xix/21, 37/iii, 48/viii, 50/xii, 52/xx.

The first dorsal pore appears to be on 11/12.

The lumen of the spermathecal duct is narrow, ectal to the diverticular junction very narrow. The ectalmost portion of the diverticulum is straight and with very narrow lumen though the wall is slightly irregular and with low, annular ridges.

EARTHWORMS FROM SINGAPORE AND THE MALAY PENINSULA

Passing entally the diverticulum is slightly widened and looped, the lumen gradually widened entally until the terminal portion which has a very thin wall. The spermatozoal iridescence is lacking only in a very short ectal portion of the looped part of the diverticulum and the straight, ectalmost portion.

Pheretima houletti (E. Perrier).

Perichaeta houletti E. Perrier 1872, N. Arch. Mus. Paris, vol. 8, p. 99.
(Type locality, Calcutta. Types in the Paris Museum).

Bukit Timah, Singapore, Feb. 1936, 2 clitellate specimens.

Pheretima indica (Horst).

Perichaeta indica Horst 1883 (part), Notes Leyden Mus. vol. 5,
p. 186. (Types with copulatory chambers only. Type locality
unknown. Types in the Leyden Museum?).

Bukit Chintamani, near Bentong, Pahang, 2 clitellate
specimens.

The Gap, Fraser's Hill, 10/7/35, 1 clitellate specimen.

Kuala Linggi, Malacca Territory (Rubber estate), Dec. 1935,
6 clitellate specimens.

Bukit Timah, Singapore, Feb. 1936, 14 acilitellate, 8 partially
clitellate and 8 clitellate specimens.

The pigmentation, a deep but not dark red is recognizable
on the dorsum of the Bukit Timah specimens which have been
preserved in formalin. Pigmentation unrecognizable on the
spirit-preserved specimens from other localities.

The Fraser's Hill specimen has secondary spermathecal
diverticula; one of the Bukit Chintamani specimens has
secondary diverticula, the other has not; the Kuala Linggi
specimens may or may not have secondary diverticula; all of
the Bukit Timah specimens that were opened have secondary
diverticula. In the Bukit Timah specimens the secondary
spermathecal diverticula may be transparent, translucent, or
opaque and with a spermatozoal iridescence.

Pheretima peguana (Rosa).

Perichaeta peguana Rosa 1890, Ann. Mus. Genova, vol. 30, p. 113.
(Type locality, Rangoon, Burma. Types in the Genoa Museum).

Singapore (cultivated land) 1935, 7 clitellate specimens.

Pheretima procera sp. n.

Bukit Timah, Singapore, Feb. 1936, 4 acilitellate and 15
clitellate specimens.

External characteristics.—Length, 85–105 mm. Diameter,
2–3 mm. Pigmentation, light red, restricted to the dorsum,
sparse posterior to the clitellum.

The setæ begin on ii on which segment there is a complete circle. The setal formulae of several specimens are shown below.

vi	vii	viii	xvii	xviii	xix	iii	viii	xii	xx
9	10	9	10	7	11	35	49	49	48
11	9	9	12	3	8	..	..	51	48
..	..	..	..	8	14	..	52	51	46
..	..	12	12	3	10	37	51	48	46
11	11	9	12	8	9	39	50	49	46
10	9	10	12	8	13	..	46	40	41
..	..	..	..	..	..	..	45	41	39

(Note.—Setal counts were not made if the setal circle is interrupted, i.e., with gaps due to falling out of seta, or if seta are so deeply retracted that they cannot be accurately counted.)

The first dorsal pore is on 11/12 (3) or 12/13 (2). In other specimens the first pore-like marking is on 10/11 (2) or 11/12.

The clitellum is annular and extends from 13/14 to 16/17; intersegmental furrows, dorsal pores and setæ lacking.

The spermathecal pores are superficial, small, transversely slit-like or crescentic apertures, four pairs, on 5/6-8/9, each pore at the centre of a transversely oval, greyish, translucent area that extends anteriorly and posteriorly onto the margins of the contiguous segments.

There is a single female pore.

The male pores are minute and superficial, each pore at the tip of a smooth, glistening, very shortly conical porophore located on a transversely oval area, the latter sharply demarcated anteriorly and posteriorly (but not mesially and laterally) by definite furrows.

Genital markings are present on all specimens, including the aclitellate individuals. The postclitellar markings are transversely oval, and 2-3 intersetal intervals wide. The preclitellar markings are usually more nearly circular and 1-2 intervals wide. Each marking has a definite, whitish, slightly raised, wide rim and a very slightly depressed, greyish, translucent, central area. External to the rim, which is sharply demarcated, the epidermis may be modified, greyish and translucent. The markings are paired (median or lateral) and unpaired. Paired median markings may be slightly separated, in contact midventrally, partially united, or united but with slight indications of fusion of two originally distinct areas. In addition to these markings there is on 17/18 and 18/19 on each side just median to the male pore line a very short (anteroposteriorly), transversely placed band of greyish translucence in the epidermis.

EARTHWORMS FROM SINGAPORE AND THE MALAY PENINSULA

These translucent areas are slightly depressed in a rather transversely slit-like fashion. The locations of the genital markings of ten specimens are shown below.

Segment vii.

- A median, presetal pair, 7 specimens.
- An unpaired, median, presetal marking, 2 specimens.
- A lateral, postsetal pair, 8 specimens.

Segment viii.

- A median, presetal pair, 6 specimens.
- An unpaired, median, presetal marking, 4 specimens.
- A lateral, postsetal pair, 10 specimens.

Segment ix.

- A median, presetal pair, 7 specimens.
- An unpaired, median, presetal marking, 3 specimens.

Segment xvii.

- A median, presetal pair, 3 specimens.
- An unpaired, median, presetal marking, 4 specimens.
- A lateral, presetal pair, 2 specimens.
- A lateral, postsetal pair, 10 specimens.

Segment xviii.

- A median, presetal pair, 8 specimens.
- An unpaired, median, presetal marking, 1 specimen.
- A lateral, presetal pair, 10 specimens.
- A lateral, postsetal pair, 2 specimens.

Segment xix.

- A median, presetal pair, 4 specimens.
- An unpaired, median, presetal marking, 5 specimens.
- A lateral, presetal pair, 8 specimens.
- A lateral, postsetal pair, 10 specimens.

Segment xx.

- A lateral, postsetal pair, 8 specimens.

The postclitellar lateral markings are usually just median to the male pore lines but are not, usually, in line longitudinally. Occasionally these markings develop anteriorly or posteriorly so as to interrupt the setal circle of their segment. The preclitellar, lateral markings are in or just median to the spermathecal pore lines.

Internal anatomy.—Septa 5/6-7/8 are strengthened but translucent; 8/9 present and complete but very delicate; 9/10 lacking; 10/11-12/13 strengthened but almost transparent.

The intestine begins in xv (5). The intestinal cæca are simple, extending through 3-5 segments, the margins smooth or with slight septal constrictions.

The single heart of ix is on the right side (2) or the left side (3). The last pair of hearts is in xiii (5). All hearts of ix-xiii pass into the ventral blood vessel.

The testis sacs are unpaired; the sac of x annular, the sac of xi cylindrical. The hearts of x and of xi and the seminal vesicles of xi are included within the testis sacs of their respective segments. The seminal vesicles of xii are fairly large, extending dorsally to the dorsal trunk and pushing 12/13 back into contact with 13/14. The prostates extend through xvii-xxi. The prostatic duct is straight, with a whitish sheen, slightly more than 1 mm. long.

The spermathecal duct is shorter than the ampulla, the lumen with rather irregular wall but wider ectally, and especially entally than in the region of the diverticular junction. The diverticulum is shorter than the combined lengths of duct and ampulla and comprises a straight stalk and an ovoidal to shortly ellipsoidal seminal chamber. The latter is 2-3 times the width of the stalk and sharply marked off therefrom. The seminal chamber is usually slightly shorter than the stalk but may be as long as the stalk or even a trifle longer. The lumen in the stalk is very narrow, the width much less than the thickness of the wall.

Remarks.—In acitellate and partially clitellate specimens the seminal vesicles are fully developed and the testis sacs are filled with testicular coagulum but the seminal chambers of the spermathecae are empty and almost perfectly transparent.

P. procera is distinguished from *P. malayana* by the larger number of genital markings and the location of some of these on the presetal portions of certain segments as well as by the larger, straight stalk of the spermathecal diverticulum.

Parasites.—Nematodes are present in the coelomic cavities of the anterior segments. In one specimen several brown discs were present in xiii, each disc composed almost entirely of nematode ova.

Diagnosis.—Octothecal, spermathecal pores superficial, transversely placed and small, four pairs, on 5/6-8/9. Male pores minute and superficial, each pore at the tip of a very shortly conical protuberance from a transversely oval, rather disc-like porophore. Genital markings small, circular to transversely oval; paired and lateral on vii (postsetal), viii (postsetal), xvii (pre- and postsetal), xviii (pre- and postsetal), xix (pre- and postsetal), and xx (postsetal); paired and median or unpaired and median on vii, viii, ix, xvii, xviii and xix (presetal only). In addition transversely band-like areas of greyish translucence on 17/18 and 18/19 just median to the male pore lines, the bands

EARTHWORMS FROM SINGAPORE AND THE MALAY PENINSULA

depressed in a transversely slit-like fashion. Setæ: vi/9-11, vii/9-11, viii/9-12, xvii/10-13, xviii/3-8, xix/8-14, 35-39/iii, 45-52/viii, 40-51/xii, 39-48/xx. First dorsal pore on 11/12-12/13. Length, 85-105 mm. Diameter, 2-3 mm.

Intestinal ceca simple. Testis sacs unpaired; of x annular, of xi cylindrical. Seminal vesicles of xi included within the posterior testis sac. Spermathecal diverticulum shorter than combined lengths of duct and ampulla and comprising a slender stalk and an ovoidal to shortly ellipsoidal seminal chamber.

Genus PERIONYX E. Perrier.

Perionyx violaceus Horst.

Perionyx violaceus Horst 1893, In: Weber, Reise Niederl. Ost-Ind. vol. 3, p. 72.

Bukit Timah, Singapore, Feb. 1936, 2 clitellate specimens.

Bukit Chintamani, near Bentong, Pahang. Dark cave, in bat guano. 1 clitellate specimen.

All three specimens are strongly contracted and in these circumstances the male genital area looks very much like that of *P. excavatus*. The two species are however clearly distinguished by characteristics of the spermathecae and the presence or absence of penial setæ.

There is an unpaired female pore or a pair of female pores.

The spermathecal ducts and the diverticular stalks are slightly better developed than those of worms previously examined (Gates, Bull. Raffles Mus. no. 10, p. 89, 1935).

Perionyx species.

Bukit Chintamani, near Bentong, Pahang, 2 aclitellate specimens. The worms are juvenile and cannot, at present, be identified.

Genus PONTOSCOLEX Schmarda.

Pontoscolex corethrurus (Fr. Müller).

Lumbricus corethrurus Fr. Müller 1857, Arch. Natg. vol. 23, p. 113.
(Type locality, Itajahy, Brazil. Types?).

Bukit Chintamani, near Bentong, Pahang, 2 clitellate specimens.

The Gap, Fraser's Hill, 10/7/35, 3 aclitellate specimens.

Mandai, Singapore, 25/2/36, 37 aclitellate and 23 clitellate specimens.

Bukit Timah, Singapore, Feb. 1936, 114 aclitellate and 117 clitellate specimens.

Chilopoden aus Malacca¹, nach den Objecten des Raffles Museum in Singapore

Bearbeitet von DR. K. W. VERHOEFF, Pasing bei München

I. TEIL SCOLOPENDROMORPHA UND GEOPHIOMORPHA,
Tafeln XII-XIX; Abb. 1-42.

Herr Curator M. W. F. Tweedie vom Raffles Museum in Singapore hatte die Freundlichkeit, mir eine Collection von Chilopoden aus Malacca zur Bearbeitung zu übersenden, wofür ich ihm auch hier meinen Dank ausspreche.

Obwohl aus der Beschaffenheit dieser Sammlung deutlich hervorgeht, dass sie nicht planmäßig sondern nur hier und da gelegentlich zusammengebracht worden ist und die grossen Formen bevorzugt worden sind, was in solchen Fällen fast immer geschieht, so ist doch die Zahl der neuen Formen eine so auffallend grosse, dass uns dadurch von Neuem zum Bewusstsein gebracht wird, ein wie gewaltiges Heer von Lebewesen in Asien noch der Entdecker harrt.

Diese grosse Zahl von neuen Formen neben nur wenigen bereits bekannten muss uns aber um so mehr überraschen, wenn wir uns vergegenwärtigen, ein wie grosses Material aus den malayischen Ländern, besonders den Sunda-Inseln schon bearbeitet worden ist. Von Malacca allerdings hat Attems 1914 in seinen indisch-australischen Myriapoden, Archiv f. Nat. Berlin, S. 24 nur drei Chilopoden-Arten angeführt und merkwürdigerweise ist von ihnen in der mir vorliegenden Collection nur eine Art vertreten, nämlich *Scolopendra subspinipes*, die in Malacca überall die grosse Scolopendra vorzustellen scheint. In verschiedenen neueren Arbeiten über tropische Myriapoden wiederholt sich die Erscheinung, dass unter den Diplopoden zwar immer wieder viele Nova auftreten, unter den Chilopoden dieselben jedoch erheblich spärlicher vertreten sind. So enthält z.B. Attems Aufsatz über "Myriapoden der kleinen Sunda-Inseln" Mitt. aus d. zoologischen Museum in Berlin, 16. Bd. 1.H., 1930 auf S. 120 unter 22 Diplopoden 9 Nova, aber unter 14 Chilopoden nur zwei Nova. Dem gegenüber ist das Ergebnis meiner Untersuchungen 32 Nova unter 37 Chilopoden um so überraschender, wenn man bedenkt, dass noch dazu die kleineren Formen zweifellos sehr lückenhaft vertreten sind. Wie so oft in meinem Leben wissenschaftlicher Arbeit bin ich auch hier an den Ausspruch erinnert worden, welcher von einem

1. Throughout this paper "Malacca" refers to the Malay Peninsula and not to the restricted territory or town of that name. Ed.